



E. coli H7 entrapment through Calcium, Potassium, Sodium, and Phosphorous-enriched biochar-sand columns

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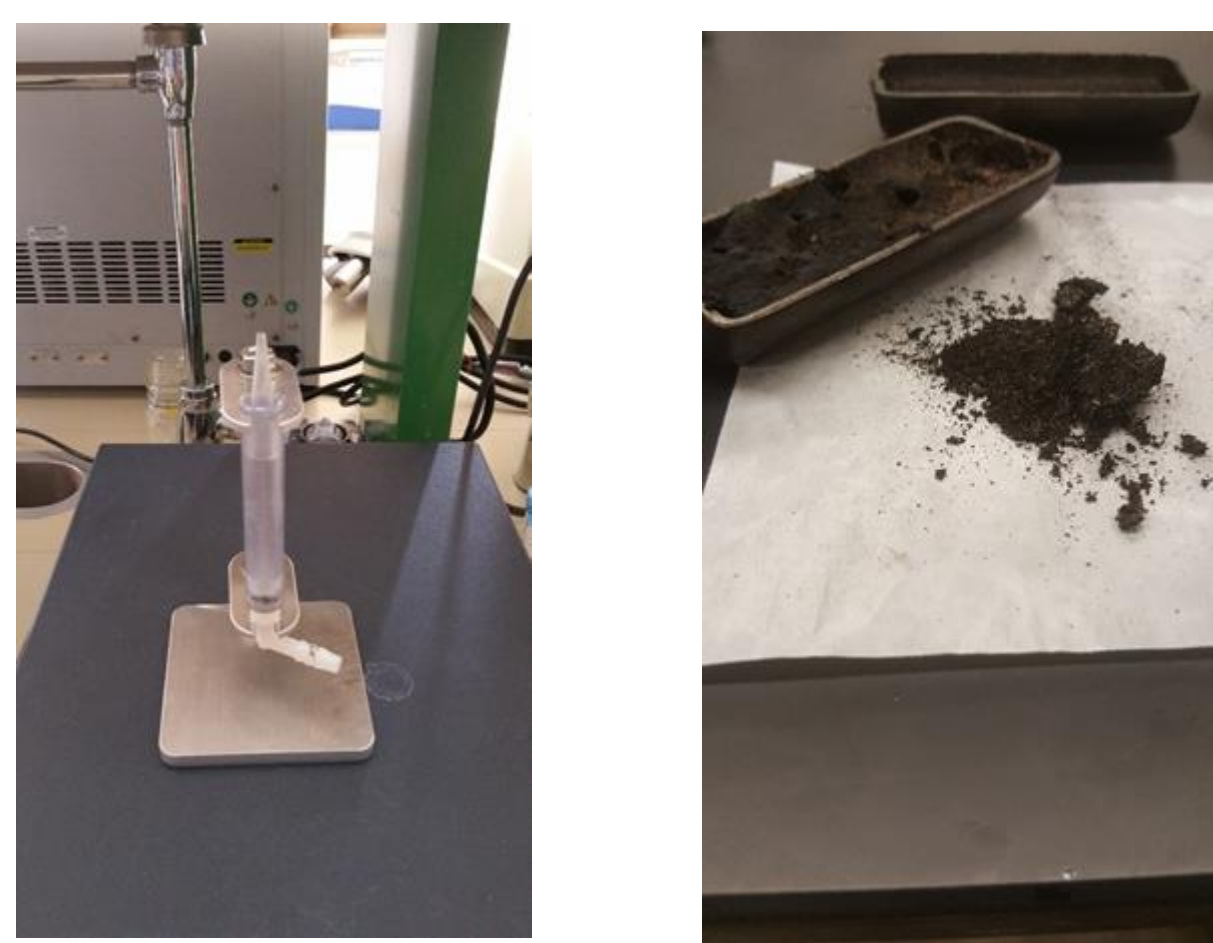


Introduction

- Biochar is a byproduct of burning bio materials such as manure and wood.
- Biochar is porous and has a large surface area.
- E. coli H7 was used in these experiments.
- Waterborne bacterial contamination is common in third world countries where access to clean water is limited.
- Cheap solutions are sought after.
- Biochar, if experiments are successful, could be used as a filtration system for contaminated water.

Method

- Pine wood is treated with K, Ca, Na, PO₄.
- Pyrolysis of pine wood is performed at 350C at a rate of 10C per minute with absence of O₂ via N₂ sweeping gas for 16 hours.
- Biochar is washed with water or acid to adjust pH level to 7.0
- E. coli H7 is incubated in LB broth for twelve hours.
- Bacteria is incubated again in new LB broth for four hours.
- Column is set up as shown with cotton and biochar inside.



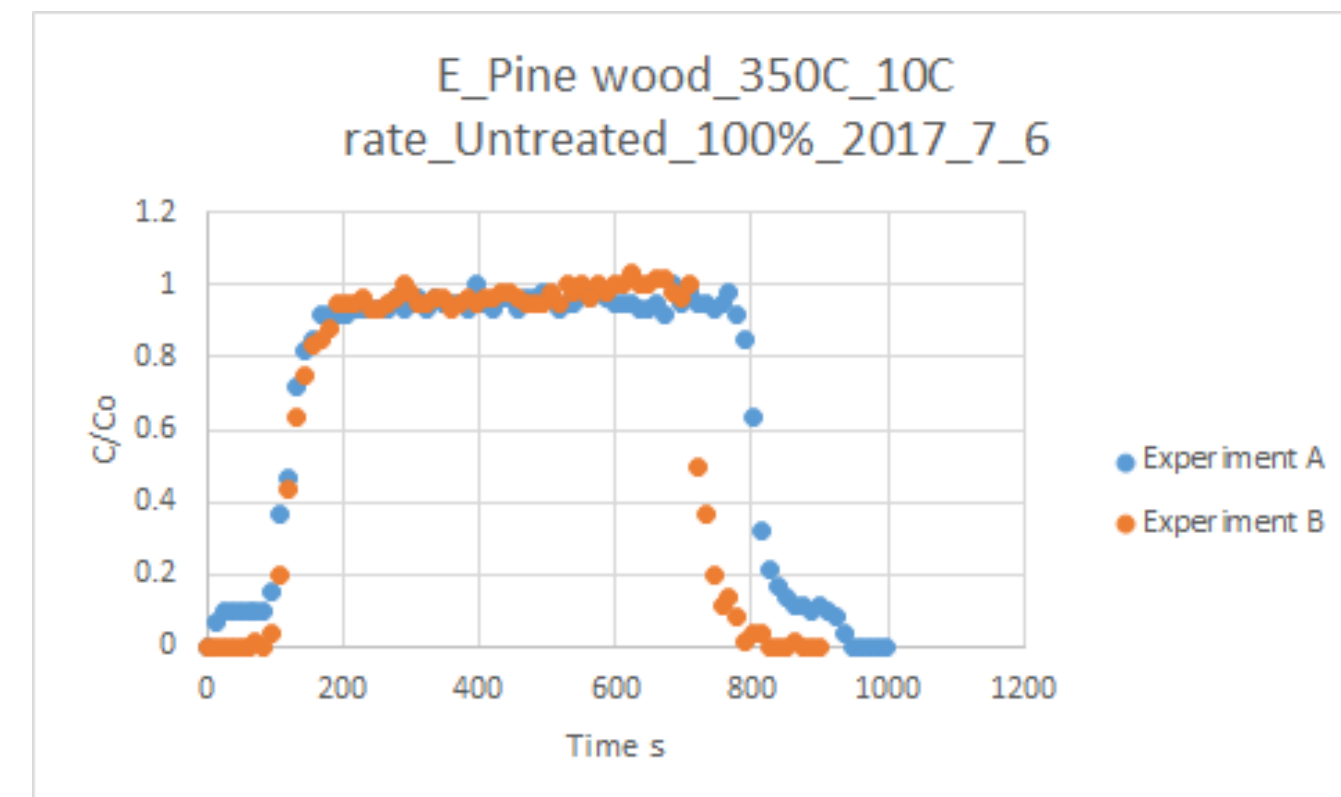
- Bacteria is filtered through the biochar in the column and photspectrometer is used to read concentration of bacteria.

Abstract

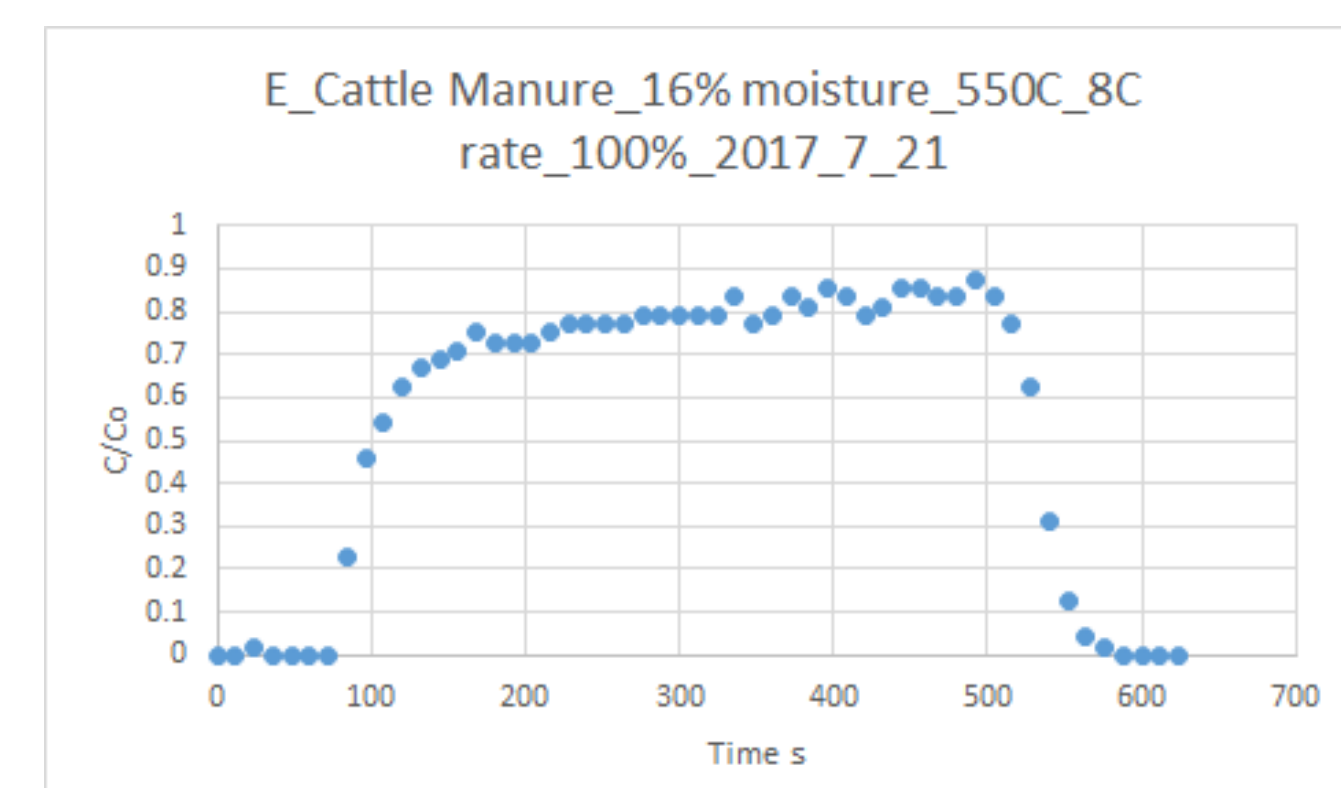
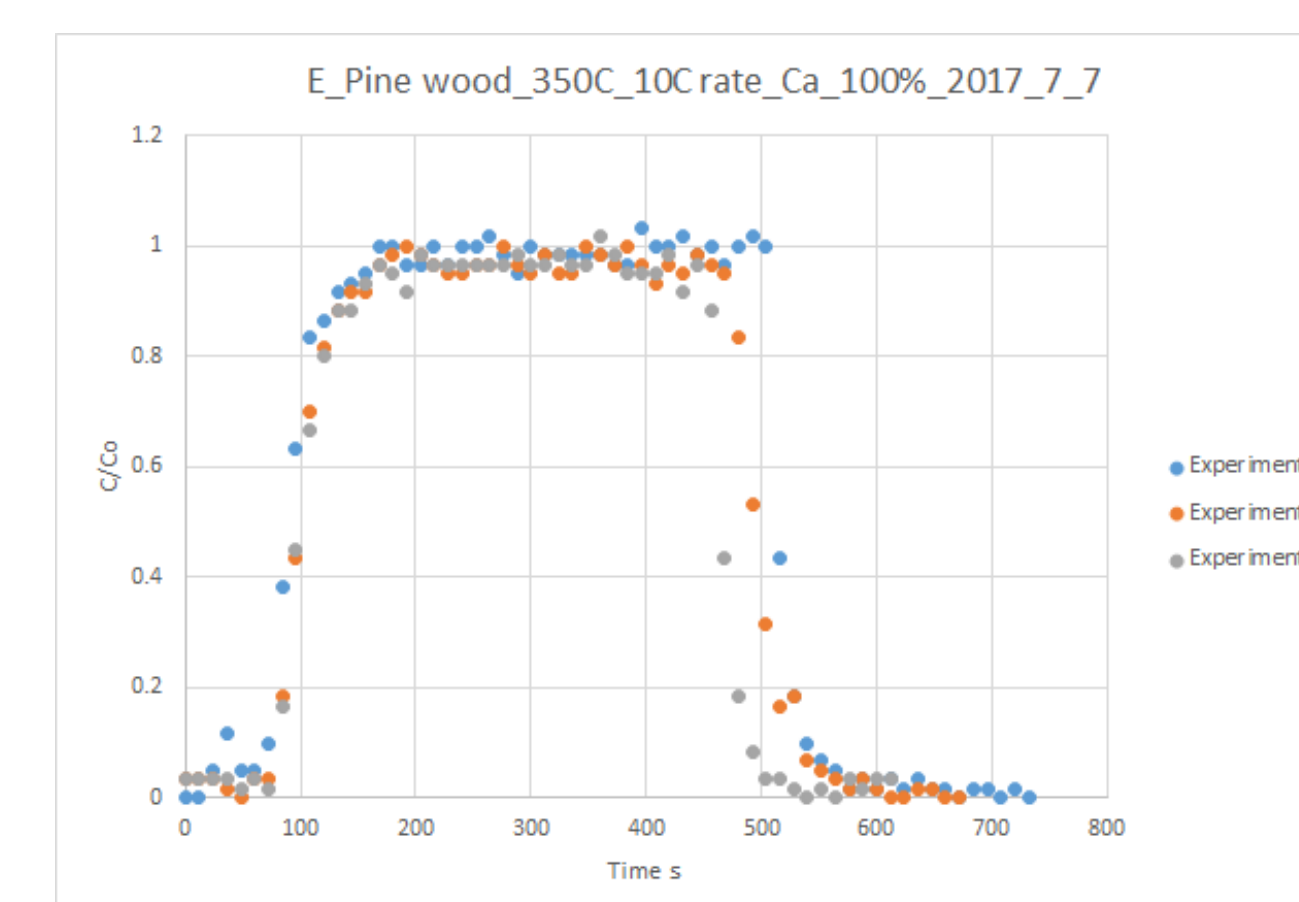
Biochar is a substance made out of burning bio materials at certain temperatures for an extended amount of time. It has many uses that range from nutrient entrapment in the soil to water filtration. Due to its porous nature, bio-char can trap bacteria and other materials in its pores. It is practical in these experiments to filter water contaminated with pathogenic Escherichia coli H7 bacteria. Groundwater outbreak and waterborne diseases which cause bacterial infections are a great concern especially in third world and developing countries where advanced water filtration systems are non-existent. By successfully trapping bacteria using biochar, economically efficient filtration systems can be implemented in needed areas where groundwater is prone to contamination. The goal of our project is to optimize the performance of a water-filtration system made of sand mixed with biochar capable of trapping E. coli H7. To achieve our goal, different pine wood biochar samples were treated with sodium, potassium, calcium, and phosphate. To make the biochar, pinewood was burnt at 350 C at a rate of 10 C per minute in the absence of Oxygen. The different mineral treatments are expected to alter the biochar polarity and other properties that affect its ability to capture the bacteria. In one experiment, untreated biochar was used and in another a biochar treated with calcium carbonate was used. A column was used to contain the biochar-sand mixture while a bacterial solution would be filtered through it. Although our test results are consistent throughout our trials, the different biochar mixtures we've experimented with have shown no signs of entrapment. Anticipated results consists of ideally blocking all of the bacteria through biochar. Ongoing efforts are focused on testing biochar samples modified with sodium, potassium, and phosphate. Another biochar that was used was that of dried cattle manure dried at 105 C to a moisture of 16%. Pyrolysis was carried out in a fix bed reactor at 550 C at a rate of 8 C per minute.

Results

- These results show our experiments with different types of biochar and treatment processes.
- Made of pine wood at 350C with heating rate of 10C per minute
- Our control sample worked as expected.
- No entrapment of bacteria was observed.



- Negatively charged biochar was treated with Ca⁺.
- No effects were observed.
- Results were identical to control experiment.
- Made under the same conditions as the control sample.



- Different biochar was used.
- Made of cattle manure with moisture of 16%.
- Pyrolysis was carried out at 550C at a rate of 8C per minute.
- Results show difference in bacterial transfer than control experiment.

Summary

- Biochar can be used as a filtration system for waterborne bacteria.
- Bacteria used were E. coli H7.
- Incubated at 37C for 4 hours to get bacteria at young stage.
- Pine wood and cattle manure were used to make biochar in these experiments.
- Pine wood biochar was treated with Ca⁺.
- No results were observed from Ca⁺ treated pine wood biochar.
- Other biochars that were treated with K⁺, Na⁺, Po₄³⁻ with no results observed as well.
- Biochar with cattle manure showed observable results.

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Discussion

- Positive ions such as Ca⁺ are good candidates to treat biochar with due to their opposite charge of the negatively charged biochar.
- Treating pine wood biochar with these ions was not successful due to unknown property of this particular biochar.
- Better results could be obtained by treating cattle manure biochar with Calcium, Potassium, or Sodium since the untreated cattle manure biochar shows promise.